

We Claim:

1. An electrically driven turf maintenance machine, which comprises:

- (a) a frame;
- (b) a plurality of ground engaging wheels attached to the frame for supporting the frame for movement over the ground;
- (c) at least one electric motor operatively connected to at least one of the ground engaging wheels for propelling the wheel to provide traction for the frame;
- (d) at least one operating unit carried on the frame for performing a turf maintenance operation;
- (e) at least one electric motor operatively connected to at least one operating unit for powering the operating unit; and
- (f) an electric drive system carried on the frame for providing electric power to the electric motors, the electric drive system comprising:

- (i) an internal combustion engine;
- (ii) an electric power generating device mechanically driven by the engine for supplying electric power;
- (iii) a battery power source for supplying electric power; and

Ins a1 (iv) ~~means~~ ^{a1} for connecting the electric motors to the electric power generating device and to the battery power source ^{at least} to allow electric power to be supplied to the electric motors ^{from} from either or both ~~of~~ the electric power generating device and battery power source. *Ins a2* ^{a2}

2. A machine as recited in claim 1, further including a switch for shutting off the internal combustion engine to thereby disable the electric power generating device, thereby making the battery power source the sole source of electric power for the electric motors.

3. A machine as recited in claim 2, whereby the switch is selectively operable under the control of a user of the machine to allow the user to select when the battery power source shall serve as the sole

source of electric power for the electric motors.

4. A machine as recited in claim 2, further including means for sensing a state of charge of the battery power source, and means for reporting the state of charge of the battery power source to a user of the machine.

5. A machine as recited in claim 4, further including a display for indicating to a user of the machine when the state of charge of the battery power source is below a predetermined minimum level.

6. A machine as recited in claim 5, further including means for preventing operation from only the battery power source when the state of charge of the battery power source is below the predetermined minimum level.

7. A machine as recited in claim 1, wherein the electric power generating device is connected to the battery power source to recharge the battery power source during operation of the internal combustion engine.

8. A machine as recited in claim 1, wherein the electric power generating device comprises an alternator.

9. A machine as recited in claim 8, further including a controller for controlling the application of electric power to the electric motors, and wherein the controller is further connected to the magnetic field windings of the alternator to control the operation of the alternator.

10. A machine as recited in claim 1, wherein two of the wheels on the frame are individually driven by separate electric motors each of which are connected to the electric drive system.

11. A machine as recited in claim 10, wherein the machine has a steering wheel to allow the machine to be turned, and further including a controller for controlling the supply of electric power from the electric drive system to the electric motors, wherein the controller has means responsive to a turn effected by movement of the steering wheel to vary

the power supplied to the individual electric motors to effect a differential action during the turn.

12. A machine as recited in claim 1, wherein the machine comprises a grass mowing machine, and wherein the operating unit comprises a grass cutting unit.

13. A machine as recited in claim 12, wherein the grass mowing machine comprises a riding lawn mower.

14. A turf maintenance machine, which comprises:

- (a) a frame;
- (b) a plurality of ground engaging wheels attached to the frame for supporting the frame for movement over the ground, wherein at least one of the wheels is steerable to allow the frame to be turned; and
- (c) a steering system for steering the steerable wheel, which comprises:
 - (i) at least one steering control adapted to be selectively moved by a user of the machine;
 - (ii) a pump operatively connected to the steering control such that movement of the steering control serves as a motive force for pumping a fluid out of one side or the other of the pump as the user operates the steering control; and
 - (iii) a cylinder having a piston mechanically linked to the steerable wheel, the cylinder being fluidically coupled to the pump such that fluid flow from the pump acts on the piston to cause the piston to move in and out of the cylinder to thereby steer the steerable wheel,

whereby the fluid contained in the pump and cylinder is not heated during operation of the pump and will not damage the turf as a result of any leakage.

15. A machine as recited in claim 14, whereby the fluid comprises a bio-degradable oil.

16. A machine as recited in claim 14, wherein the steering control

comprises a rotatable steering wheel.

17. A turf maintenance machine, which comprises:

- (a) a frame;
- (b) a plurality of ground engaging wheels attached to the frame for supporting the frame for movement over the ground,
- (c) a plurality of operating units carried on the frame for performing a turf maintenance operation; and
- (d) a lift and lower system carried on the frame for raising and lowering the operating units, wherein the lift and lower system comprises:

- (i) a rotatable crankshaft;
- (ii) a plurality of crankarm and connecting rod linkages for connecting each of the operating units to the crankshaft; and
- (iii) means for rotating the crankshaft such that rotation of the crankshaft in a first increment of rotation raises the operating units and rotation of the crankshaft in a second increment of rotation lowers the operating units.

18. A machine as recited in claim. A machine as recited in claim 17, wherein the crankshaft rotating means comprises a powered motor.

19. A machine as recited in claim 17, wherein the crankshaft rotating means comprises a single electric motor.

20. A machine as recited in claim 17, wherein the crankarm and connecting rod linkage to at least one of the operating units differs from the crankarm and connecting rod linkages to other of the operating units to allow the at least one operating unit to raise and lower at different times than the other operating units during the first and second increments of rotation.

21. A machine as recited in claim 17, wherein the means for rotating the crankshaft effects uni-directional rotation of the crankshaft such that the second increment of rotation follows the first increment of rotation.

22. A machine as recited in claim 21, wherein the first increment of rotation is from 0 to 180° of rotation of the crankshaft and the second increment of rotation is from 180 to 360° of rotation of the crankshaft.

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